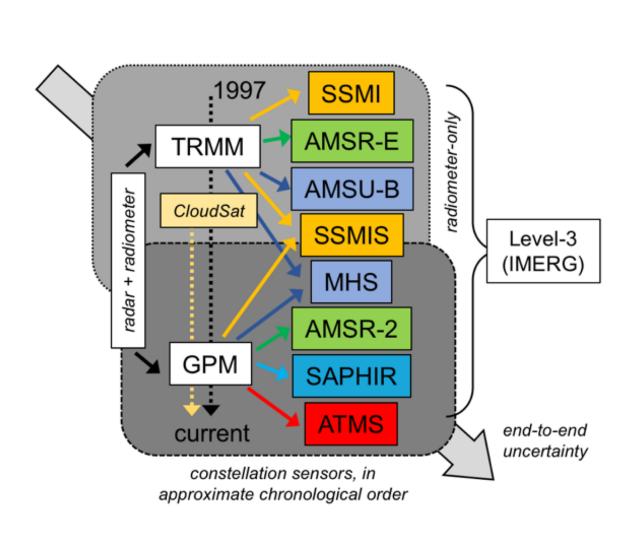
Consistent Adaptation to Surface and Environmental Conditions Between Passive MW Imagers and MW Sounders

Summary

The GPM and TRMM constellations are a mixture of MW imagers with different sampling and characteristics. The coverage needed to maintain a sub-3-hour revisit across mid-latitude areas is captured by the many wideswath MW sounders, such as ATMS and MHS, with their variable resolution relative to MW imagers such as GMI. A desirable goal is a common method to directly transfer the Level-2 observations and products from the single GPM or TRMM radar (not only precipitation rate, but the associated vertical structure and type of precipitation) across all passive MW imagers and sounders in the TRMM+GPM era constellation. Furthermore, this method should also retain consistency with the surface and environmental characteristics at the time of each satellite overpass.



Why is this important?

The most requested products from the gridded Level-3 products, such as IMERG. At its core. evolves the precipitation structure from satellite-1 (taken at time 1) and satellite-2 (taken at time Satellites 1 and 2 can be from satellites/sensors in the constellation common method to reference directly to the core radar products leads to a high level of consistency amongst the various radiometer-only precipitation products that eventually feed Level-3 products.

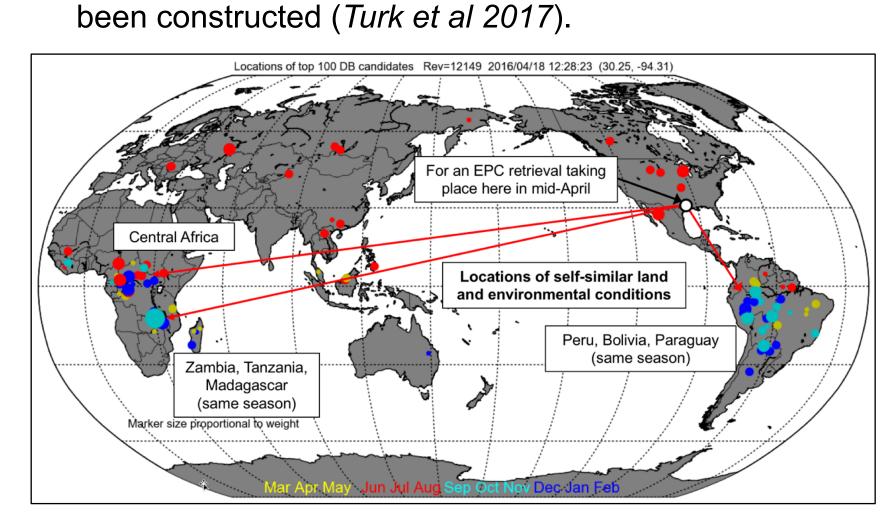
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With acknowledgements to the PMM Land Surface Working Group

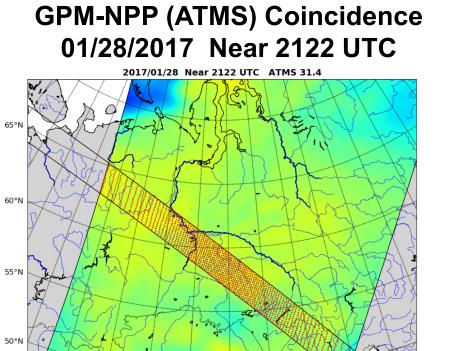
GPM (left) GCOM-W (right) (12-min separation)

The emissivity principal components (EPC) method uses the leading PCs of the surface emissivity vector to index and link to observational a-priori databases. Since the EPC elements can be estimated from the radiometer TB observations, no ancillary model nor surface information is needed after the a-priori has



Turk F.J., Z.S. Haddad, P. Kirstetter, Y. You, S. Ringerud (2017). An observationally based method for stratifying a-priori passive microwave observations in a Bayesian-based precipitation retrieval framework. Q.J.R. Meteorol. Soc. doi:10.1002/qj.3203

EPC Top-Ranked DPR Ku DPR+GMI 10-chan AMSR-2



MHS-DPR NS swath)

Top-ranked CMB-MS candidate

15 20 25 30 35 40 45

DPR Zmeas from a-priori (dB)

₹_{10.0}

<u>ਨ</u> 8.0 |

£ 6.0 ⊦

Actual DPR Zmeas

15 20 25 30 35 40

DPR Zmeas (dB)

Each dot is an ATMS

pixel (database entry)

within the DPR swath

Observational *a-priori* Databases for each Sensor

Four years (thru April 2018) of DPR Ku- and Ka-band Zmeasured profiles and precipitation rate retrievals from ±15-min coincidences between GPM and each of the constellation radiometers (GMI, SSMIS, ATMS, MHS, AMSR2, SAPHIR) are directly transferred into the databases, along with other DPR products (e.g., precipitation type classification, shallow rain flag, elevation), and ancillary environmental fields from the MERRA2 reanalysis. Four radar retrievals are added: the Ku-only (NS) and Ku/Ka (MS)-based estimates from the DPR and the combined DPR+GMI (CMB). This allows joint verification of the EPC-estimated surface precipitation and the DPR vertical structure profiles that were selected by the radiometer-only EPC retrieval. Since the EPC requires no ancillary data (once the a-priori databases have been constructed), the actual surface and environmental conditions at the time of the overpass can be compared with the top EPC-selected candidate profiles. Examples from ATMS and MHS are shown below.

MHS METOP-A Bhutan-Tibetan Plateau (28N, 89E) 2016/05/17 1513 UTC (Ascending) **EPC-Estimated precip, using MERRA2 Surface Temp** MHS 190.31V (K) MHS 89V (K) **DPR-MHS** database and at overpass time **CMB-NS** precip **EPC-Estimated** Surface Temp **Actual CMB-NS precip MHS-DPR** transect **DPR Ku-band** 2016/05/17 1513 UTC Ret=MS Top-Ranked DPR Ku-band METOPA MHS BeamPos=61 **EPC** picks up sharp Ts and 2-m air temp But not here, on the cold side of the overpass terpolation of model fields across a sharp gradient) 84°E 87°E 90°E 93°E 96°E 2016/05/17 1513 UTC Observed DPR Ku-band METOPA MHS BeamPos=61 MERRA2 2-m Air Temp at overpass time Outside of Intersecting DPR NS swath 84°E 87°E 90°E 93°E 293 **EPC-Estimated** 2-m Air Temp 2016/05/17 1513 UTC Observed DPR Ka-band METOPA MHS BeamPos=61 **EPC-Estimated 20dB** Outside of intersecting DPR MS swath top Ku-band (km) > 15-km tops **CFADS* Ku-band (from within intersecting**

CFADS* Ka-band (from within intersecting MHS-DPR MS swath) **Actual DPR Zmeas Top-ranked CMB-MS candidate** Actual DPR 20dB top **≚**10.0 5 8.0 6.0 15 20 25 30 35 40 DPR Zmeas (dB) DPR Zmeas from a-priori (dB) *contoured frequency by altitude diagram

ATMS Suomi-NPP Between Kalimantan and Sumatra (2S, 108E) 2016/02/09 0613 UTC (Ascending)

